CENPP-PE-HR (1110-2-1150) 5 May 1992

MEMORANDUM FOR Chief, CENPP-OP, ATTN: CENPP-OP-NW (Braun)

SUBJECT: Update on Suitability of Winchester Bay Sediment for Development of Wetlands Habitat in Constructed Dunal Ponds on the North Spit of the Umpqua River

1. Enclosed is an update on the suitability of Winchester Bay sediment for use as liner material in constructed ponds in the sand dunes of the North Spit of the Umpqua River. The sediment is high in clay content which should help seal off the bottoms of the constructed ponds thereby creating habitat for a longer period of time during the year. Contaminants such as metals, pesticides and PCBs in bulk sediment are below concern levels. The PAH analyses are suspect and the sediment will be re-sampled and re-analyzed for PAHs. It is predicted that the concentrations of metals in pond water overlying the sediment will be below concern levels. However, to be sure of this, elutriate tests will be performed on the sediment to verify that metals concentrations are acceptable. The sediment, since it comes from an estuary, will initially be saline and so will the pond water. In time the salts will leach out of the sediment and the ponds will become freshwater wetlands habitat. The shift in the salinity of the habitat will cause a shift in the types of organisms colonizing the ponds over time. The net result of using Winchester Bay sediment for this beneficial use should be increased wetlands habitat in the sand dunes.

2. If you have questions, regarding this sediment evaluation, please call Jim Britton, CENPP-PE-HR, extension 6471.

STEVEN L. STOCKTON, P.E.
Chief, Planning and Engineering Division

Enclosure

CF:
CENPP-PE
CENPP-PE-H (Read File)
CENPP-PE-HR (Cassidy)
✓CENPP-PE-HR (Britton)
NPP-PE-G

CENPP-PE-MS
CEN/FILES

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BRANCH
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Update on Suitability of Winchester Bay Sediment for Development of Wetlands Habitat in Constructed Dunal Ponds on the North Spit of the Umpqua River

1. **Previous studies.** Previous studies of Winchester Bay sediments were conducted in 1980, 1981, 1985 and 1987 (1-4). The results are summarized as follows: The sediment within the boat harbors is high in fines and clay. It appears black and greasy. There was concern that it might be contaminated with organics. However, over the years, tests for unacceptable levels of organics have proven negative. In 1980 four samples from within the bay were analyzed and found to have less than 1,000 ppm oil & grease and less than 500 ppm hydrocarbons (gasoline & diesel). In 1985 six samples were analyzed for grain size and oil & grease. Oil & grease averaged 456 ppm which is well below Portland District concern levels. In 1987 twelve samples were taken from the boat basins. Metals were below concern levels. Pesticides, PCBs and PAHs were undetected. Elutriate tests showed that metals did not exceed EPA guidelines for fresh or salt water. Bioassays were conducted on Winchester Bay sediment in 1980 to test its suitability for in-water disposal at an Ocean Dredged Material Disposal Site (ODMDS). The tests included bioassays of liquid, suspended particulate, and solid phases of the material. Only the solid phase test showed some toxic potential to the organism Rhepoxynius epistomus, a burrowing amphipod . This was thought to be because the grain sizes of the Winchester Bay sediment were different from those which the organism preferred. No significant impacts were anticipated from in-water disposal of Winchester Bay sediment at an ODMDS.

2. **Current study.** Sediment from Winchester Bay has been proposed for use as liner material in ponds to be constructed in the sand dunes of the north spit. The sediment would "seal" the ponds helping them hold water and would retain soil moisture longer than the existing sand substrate. These ponds would provide aquatic habitat for a longer period of time during the year. Winchester Bay sediment is high in fines and organic carbon and comes from a marina environment where contaminants may accumulate. To assure that Winchester Bay sediment is suitable liner material, it was decided that tests for contamination were needed even though previous studies had shown no reason to believe contaminants were present. On September 11, 1991 ten sediment samples were taken by Gray O'Hare box-corer from Winchester Bay (see map). All samples were analyzed for grain size distribution, volatile solids and total organic carbon (TOC). The physical analyses should verify the "sealant" properties of the sediment. Chemical analyses for heavy metals, pesticides, polychlorobiphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), tributyltin (TBT) and acid volatile sulfides (AVS) were conducted on 6 samples. The analyses were conducted by Columbia Analytical Associates, Kelso, Washington. The results of chemical analyses will help in predictions of biological consequences to the intended use of the sediment. The results will be used to assess potential acute and chronic impacts to pond organisms residing in and colonizing the pond water column and sediment.

Results/discussion.

3. **Physical analyses.** The results of physical analyses are presented in Table 1. The sediments averaged 36.6 % sand and 64.9 % fines (49.0 % silt and 15.9 % clay). The median grain size of the sediment within the marinas was that of medium to coarse silt. The grain size at the marina entrances was that of very fine to fine sand. The grain size of the channel

sediments decreased proceeding from the area of the entrance to the back end of the boat harbors- as would be expected. Volatile solids averaged 9.6 % and TOC 3.91 %. These results are typical of Marinas where fine grained sediment settles out of quiescent water. The results are similar to those of earlier studies. The high silt/clay content of the sediment should make it an excellent liner for constructed ponds.

4. **Metals.** The results of chemical analyses are shown in Tables 2 and 3. All values are reported on a dry weight basis. The means of heavy metals concentrations for all the sediment samples were below Portland District and EPA Region 10 screening levels. Individual samples did not exceed screening levels either. Tributyltin (TBT) concentrations averaged 5.2 ppb and were below EPA Region 10 screening level (30 ppb). The mean acid volatile sulphur (AVS) content was 70.5 µm/g, or roughly 0.2 percent. Sulphur combines with metals in sediment to form insoluble sulfides. This can reduce the toxicity of metals in sediment (5).

5. **Pesticides/PCBs.** As in the 1987 study, no pesticides or PCBs were detected (Table 3). The detection limits (DLs) of the analyses for pesticides, PCBs and PAHs were above Portland District guidelines (see Table 3 for DL guidelines). The probable reason for the higher detection limits was the high concentration of sulfur in the sediment which interferes with detection of signal from the sample (6). The sediment averaged 0.23 % sulphur on a dry weight basis. The 1987 study of Winchester Bay sediments had much better DLs for pesticides and PCBs than did the current study (1-10 ppb vs 100-1,000 ppb). The difference was due to the method used to clean up the sample prior to analysis and to the method used in the analysis. The 1987 samples were analyzed using an EPA approved method for waste-water while the 1991 samples were analyzed using an EPA method for soils. It is probably safe to conclude, based on the 1987 study which also did not detect any pesticides or PCBs, that the levels of these compounds in Winchester Bay sediment are below Portland District and EPA, Region 10 screening levels. There are no known sources or reasons to believe pesticides or PCBs would have been introduced since 1987.

6. **PAHs.** Of the polynuclear aromatic hydrocarbons (PAHs), only Benzo (a) anthracene (BaA) was detected at between 800 and 2700 ppb. It was found in 5 of 6 samples tested. The amounts of BaA found in the samples exceeded the EPA Region 10 screening level (450 ppb) for that chemical. This PAH was not detected in the samples analyzed in 1987. The lack of other PAHs detectable in the sediment samples is puzzling. The analysis looks for 15 different PAHs. Usually, there are a suite of PAHs found in a sample not just a single PAH. For instance, in the Portland District database there are 39 sediment samples from 9 different projects which have detectable BaA. Of these, only the 5 from Winchester Bay show only BaA in them. The other 34 samples contained an average of 12 other PAHs. A phone conversation with the quality control person at the analytical lab yielded the following observations: 1) the original chromatograms were examined and found to show spikes for BaA. 2) However, when the original extract with the highest concentration of BaA was re-analyzed, none was found! This sample was stored sealed in a refrigerator for 5 months. Its possible that all the BaA was volatilized and lost under these conditions. 3) Another extract was analyzed using a different method (HPLC) to determine if PAHs are present. The HPLC analysis showed that there were some low levels of other PAHs in the sample but no BaA. In view of these difficulties verifying the existence of BaA in the samples, the confusion over whether other PAHs are present, and the high detection limits, it will be necessary to re-sample and re-analyze the sediment in order to determine the PAH concentration. The DLs for PAHs were about the same or perhaps marginally better in the current study versus the 1987 study. As mentioned above, this is probably due to the fairly

high sulphur concentration in the sediment.

7. **Recommendations.** The sediment in Winchester Bay is probably suitable for use as liner material for constructed dunal wetland ponds. The relatively high clay and silt content should help seal off the bottoms of the ponds thereby reducing water loss. The ponds should provide habitat for wetland plant and animal communities for a longer period of time during the dry season. However, there are three areas of possible concern that need to be addressed in an environmental assessment of the project. They are ; 1) the PAHs levels in the sediment; 2) the metals concentrations in pond water following the dry season when the sediment may dry out and become oxidized; and 3) the salinity of the sediment and pond water. The discussion below addresses these issues and shows that the probable impacts to the project are minimal.

8. First, an accurate accounting of the PAHs in the sediment is needed to assess potential environmental impacts. The detection limits in the analyses of the current samples were unacceptable according to Portland District guidelines. The finding of only 1 PAH in the samples is suspicious. PAHs were not detected in an earlier study (1987) which also had high detection limits. There are no known local sources of PAHs other than combustion products from boat engines or possible local spills of petroleum products, although none have been documented. If the sediment is typical of other coastal marinas in the Portland District, the concentrations of PAHs will be below EPA, Region 10 concern levels which are 1800 ppb for high molecular weight PAHs and 610 ppb for low molecular weight PAHs. During the summer, the drying-up of the ponds will expose the sediment to sunlight and air which will contribute to the breakdown of any PAHs in the surface layer. The Winchester Bay sediment is probably not contaminated with PAHs, but to be sure, the sediment will be re-sampled and re-analyzed.

9. Second, the concentrations of metals in pond water associated with dry sediment needs to be assessed. When the ponds dry up as can happen in the summer, the sediment can become oxidized and potentially release metals to pond water when ponding resumes in the rainy season. Studies have shown that when sediment drys it becomes aerobic and acidic (7,8). The pH drop can be substantial, especially if there is a high sulphur content (say, 1-2 %). Fortunately, the Winchester Bay sediments are not that high in sulphur content (0.2%). It's estimated that the pH will not drop below pH 5.0 (9). The change in acidity and the oxidation of metals in the dry sediment can lead to increased solubility of metals and therefore increased metals concentrations in the pond water when ponding occurs after the dry season. For Winchester Bay sediment it is not anticipated that metals concentrations will increase above concern levels. Any increase will be temporary because the clays and organics in the sediment will rapidly re-adsorb the metals from the pond water as the sediment once again becomes anaerobic. Because of the low levels of metals in the sediment it is not anticipated that organisms in the sediment or water column will be adversely impacted. Leachates from the sides and bottom of the pond are expected to be below concern levels for contaminants.

10. To be certain metals concentrations in pond water will be no problem, it is recommended that wet and air died sediment be subjected to elutriate tests. This will help predict effects on aquatic organisms. Elutriate tests are conducted by adding water to some sediment in a container, shaking the container for a specified period of time, then allowing the sediment to settle out, again for a specified period of time. The overlying water is then drawn off, filtered or centrifuged, and measured for metals concentrations. Elutriate tests of wet, anaerobic Winchester Bay sediment, conducted in 1987, showed that the metals concentrations do not exceed EPA water quality criteria, both acute and chronic (4). Would elutriate test results

show metals concentrations to exceed concern levels if dry, oxidized sediment were used? Even if elutriate tests of dry sediment showed a ten fold increase in the concentrations of metals in water, the levels would be well below EPA water quality criteria.

11. A way to determine the effects of the drying of the sediment on the availability of metals to aquatic plants which may colonize the site is to measure DPTA extractable metals in wet vs dry sediment. DPTA extraction mimics plant uptake of metals. If the proposed elutriate tests indicate a problem with metals concentrations, which is highly unlikely for this sediment, then perhaps the DPTA tests could be performed.

12. Third, over time, what will be the effects of saline sediment on pond water salinity and the type of organisms colonizing the ponds? The salinity of pond water will gradually decrease as salts are leached out from the sediment by fresh water. But this will take some time as the clayey nature of the sediment will slow leaching of salt from the sediment. When the sediment drys out in the summer the salts will again be mobilized when ponding resumes and the salinity of the pond water will initially be high, then decrease as fresh water leaches more salt from the system and more water enters the ponds. Eventually the ponds may become freshwater ponds unless groundwater coming into the ponds is saline. These conditions should initially lead to establishment of salt tolerant aquatic organisms in the ponds. Later, freshwater organisms may take hold.

13. The following should be considered in further evaluations of the project if feasible. These are low cost tests that will firm up the biological assessment of the Winchester Bay sediment.

a. Re-sample the sediment and re-analyze for PAHs.

b. Conduct elutriate tests on wet and dry sediment.

c. Measure the pH of wet and dry sediment.

d. If necessary, measure DPTA extractable metals in wet and dry sediment.

e. If necessary, conduct a leachate test (only if metals exceed concern levels in pond water, a not very likely scenario).

12. It is also recommended that monitoring of the ponds be conducted to determine biological impacts and the succession of organisms colonizing the site. In this connection Waterways Experiment Station has expressed an interest in doing some studies on the ponds, using some of their money from the Wetlands Program. Perhaps funding could be a joint Corps, W.E.S. and Forest Service venture.

Table 1.

Results of Physical Analyses of Winchester Bay Sediment.

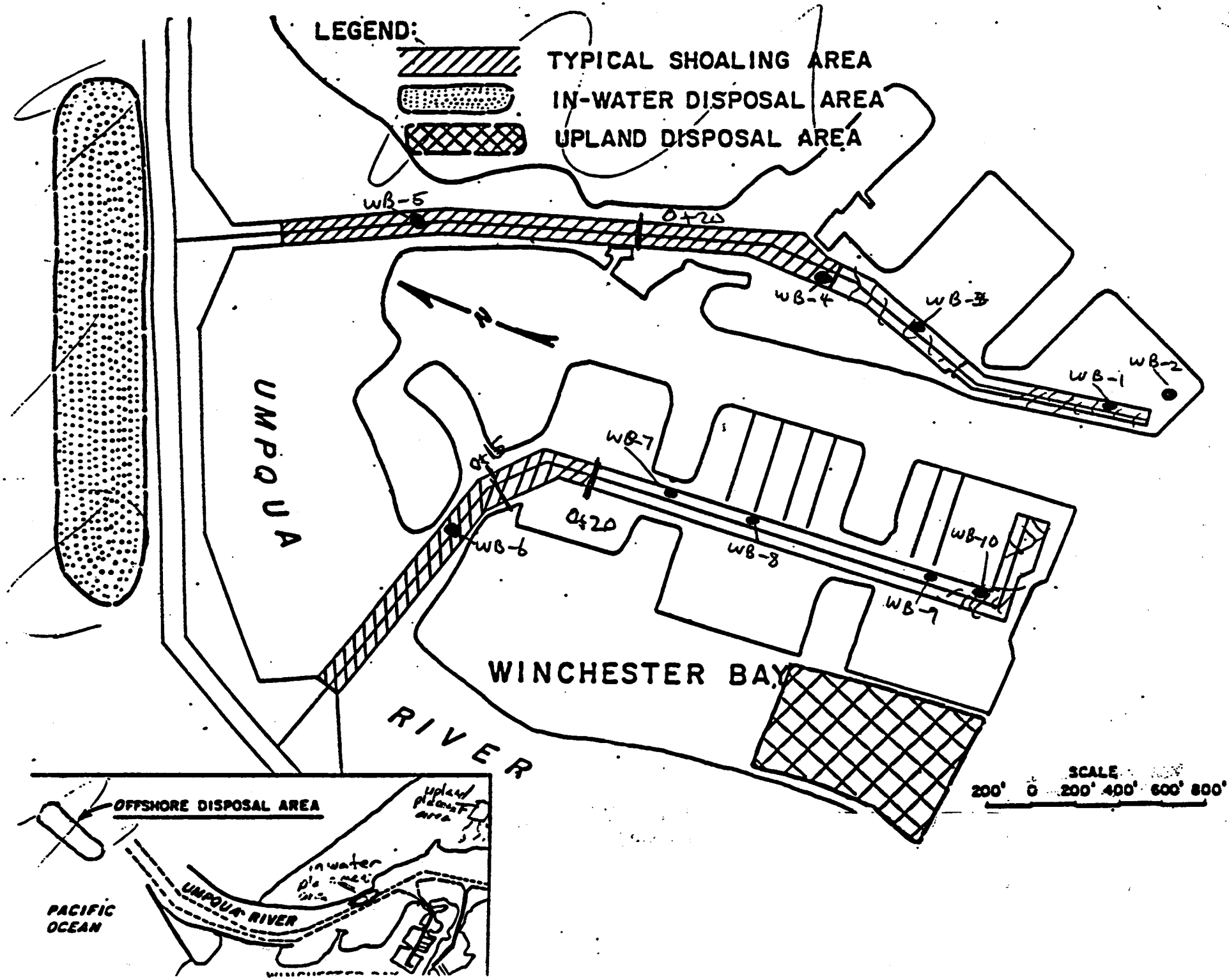
sample	median gr. size	sand	silt	clay	vol. sols	TOC
	(mm)			%		
WB-1	0.019	15.1	69.7	15.2	2.8	3.95
WB-2	0.016	10.9	70.9	18.2	13.4	-
WB-3	0.032	25.3	59.8	14.9	10.1	3.33
WB-4	0.069	51.9	36.7	11.4	9.6	5.01
WB-5	0.093	66.2	22.6	11.2	12.8	-
WB-6	0.180	99.4	0.6	-	1.9	-
WB-7	0.041	39.9	43.3	16.8	10.8	4.20
WB-8	0.038	34.1	51.1	14.8	11.7	3.61
WB-9	0.019	13.5	67.2	19.3	11.3	3.36
WB-10	0.016	10.0	68.3	21.7	11.7	-
mean	0.052	36.6	49.0	15.9	9.6	3.91

Table 2.

Results of Chemical Analyses of Winchester Bay Sediment for Metals, TBT and AVS.

sample	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn	AVS	TBT
					ppm				µm/g	ppb
WB-1/2	5.0	0.5	56	34	0.08	55	10	75	68.7	4.6
WB-3	5.0	0.5	61	34	0.07	58	8	79	62.6	14.4
WB-4	5.0	0.4	46	25	0.06	46	6	60	57.8	5.2
WB-7	5.0	0.6	56	26	0.06	55	8	66	89.6	<2.3
WB-8	5.0	0.4	54	27	0.06	57	7	67	75.7	2.4
WB-9/10	5.0	0.5	60	34	0.11	60	8	77	68.7	<2.3
mean	5.0	0.5	56	30	0.07	56	8	71	70.5	5.2
SL*	57	0.96	180	81	0.21	140	66	160	-	30

* SL = EPA Region 10 screening levels developed for Puget Sound estuary



MAP - WINCHESTER BAY